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(54) METHOD AND APPARATUS FOR HEALTH AND DISEASE MANAGEMENT COMBINING PATIENT DATA MONITORING WITH WIRELESS INTERNET CONNECTIVITY

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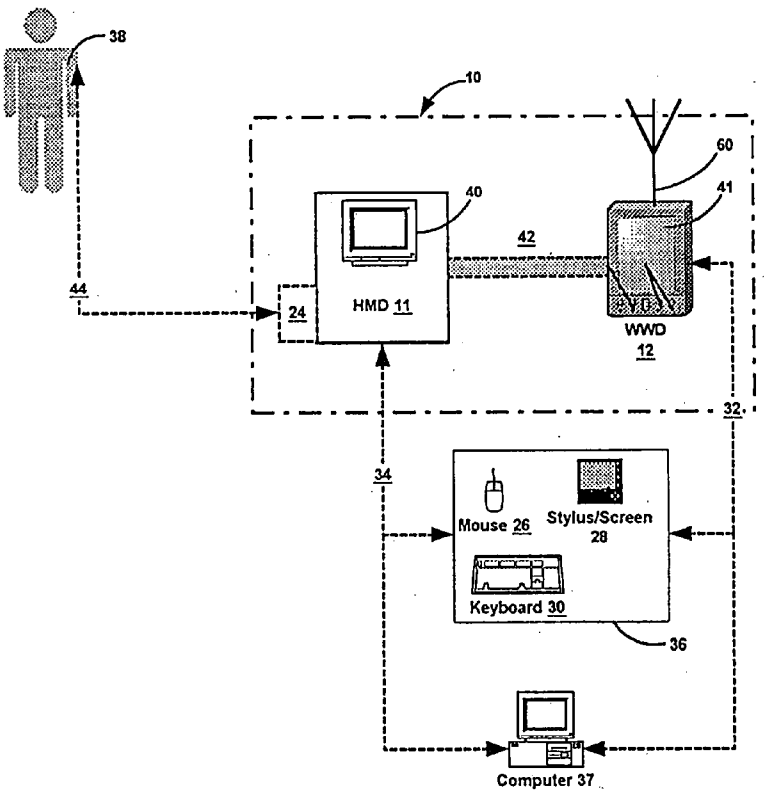
(57) **ABSTRACT**

Embodiments of the invention provide a method and apparatus for a wireless health monitoring system for interactively monitoring a disease or health condition of a patient by connecting an internet-enabled wireless web device ("WWD") to a health monitoring device which may be a medical device or other health related device such as an exercise machine. The WWD may be connected to the health monitoring device directly by a wired connection to a generic input/output port of the WWD using an optional adaptor if necessary. Alternatively, the WWD may be wirelessly connected to the health monitoring device, such as via an infrared or radio frequency connection, including using protocols such as Bluetooth or 802.11. The wireless connection may also employ an adaptor if necessary. The user may also input data to the WWD manually, such as by a keypad, keyboard, stylus, or optionally by voice command.

The health related data is transmitted from the WWD to a server using standard internet protocols. The server calculates a response using a software program which may include an algorithm or artificial intelligence system, and may further provide for review by a physician or health specialist. The user may interact with the server. For example, the server transmits a response to the WWD, and the user may answer the response or provide other information.



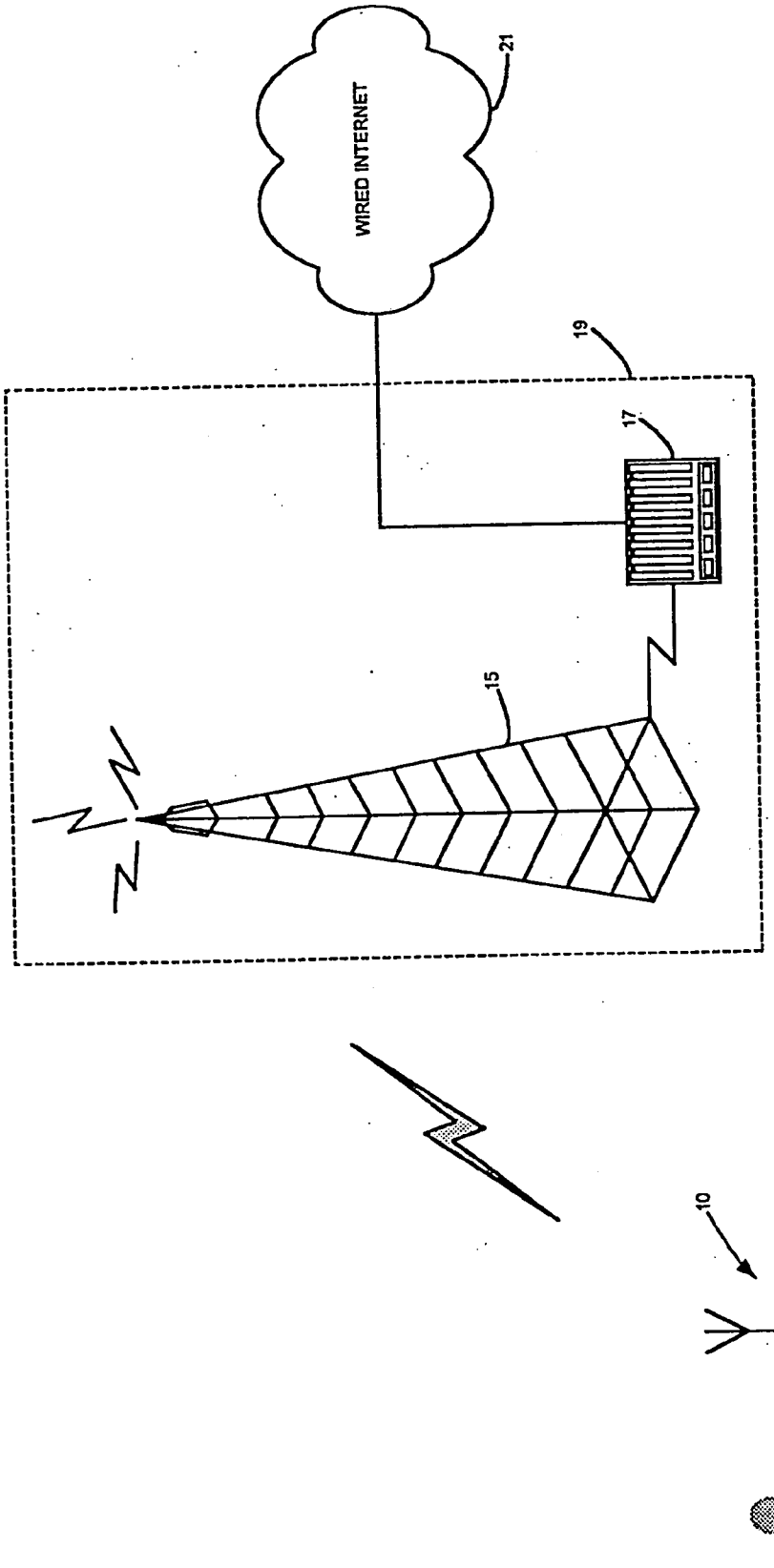


FIG. 1

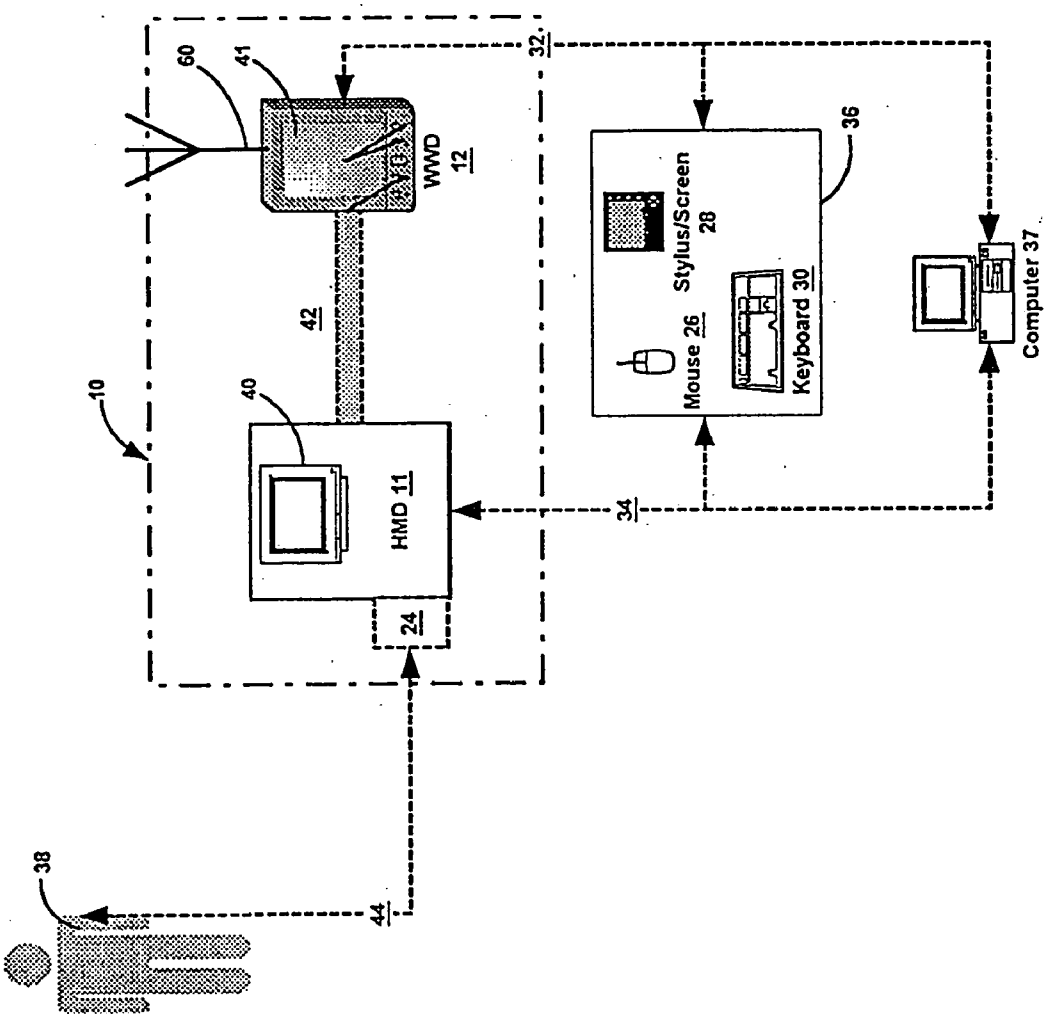

60
41
WWD 12
32
36
Stylus/Screen 28
Mouse 26
Keyboard 30
Computer 37
42
10
40
HMD 11
34
24
38
44

FIG. 2

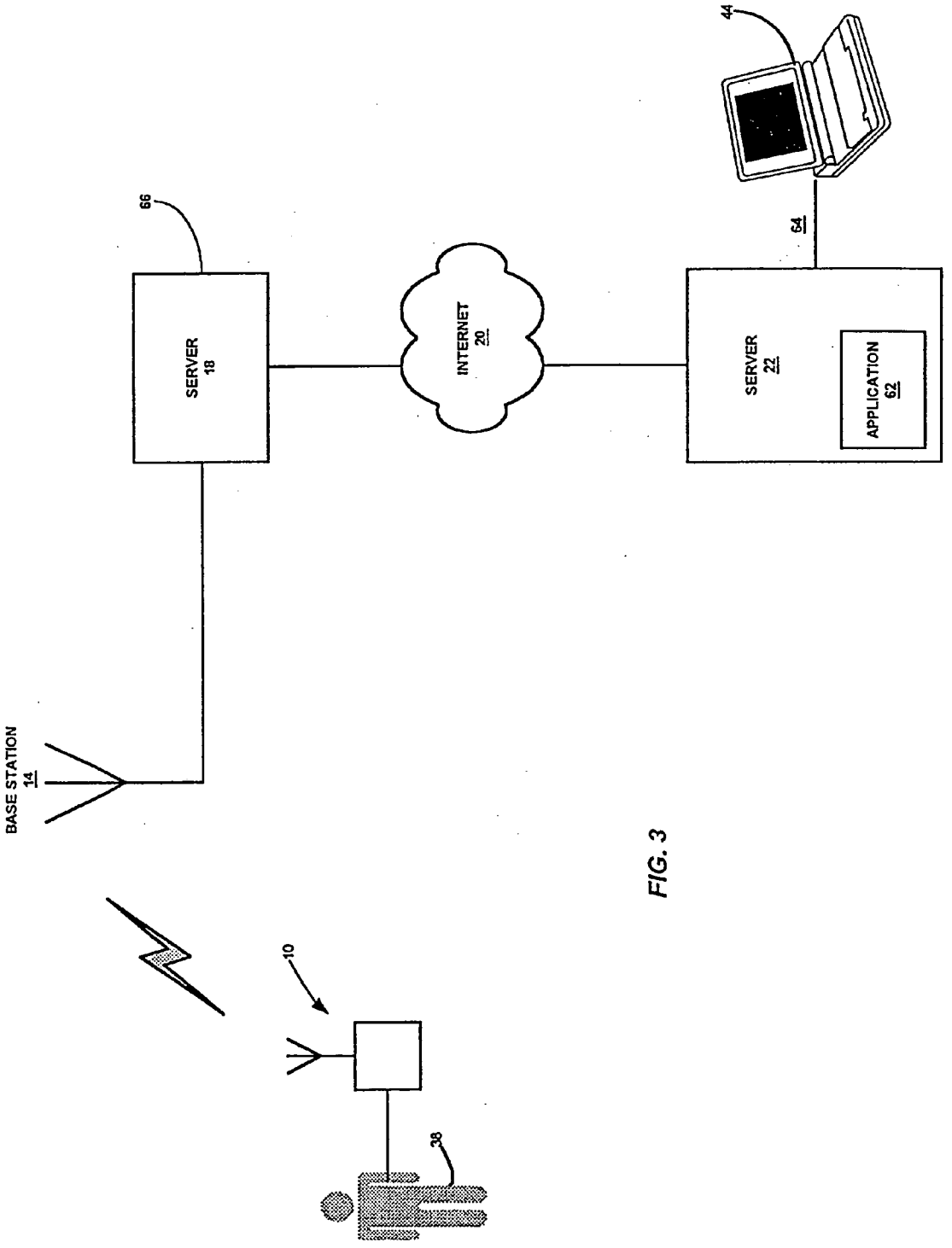
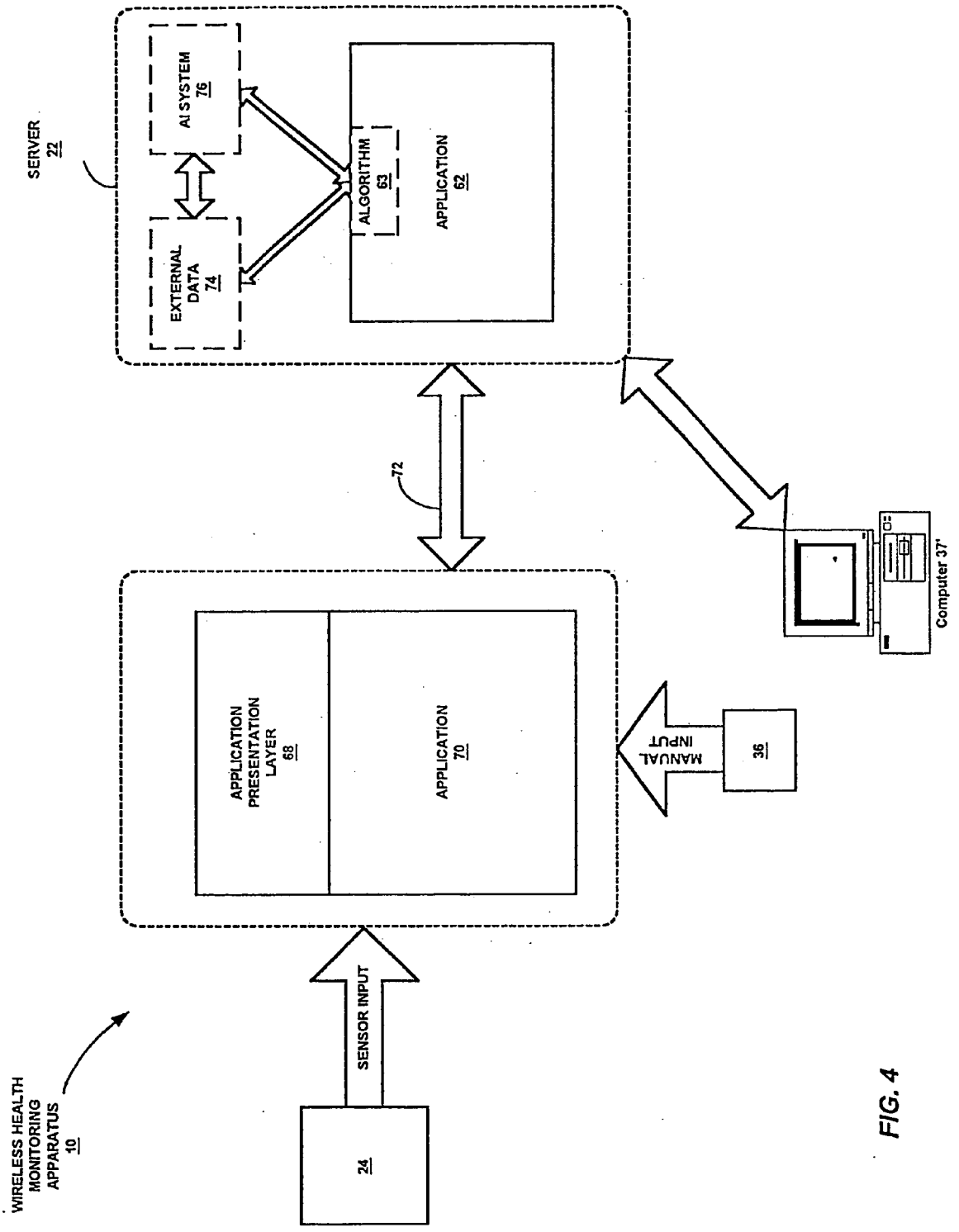

44
64
66
SERVER
18
INTERNET
20
SERVER
22
APPLICATION
62
BASE STATION
14
10
38

FIG. 3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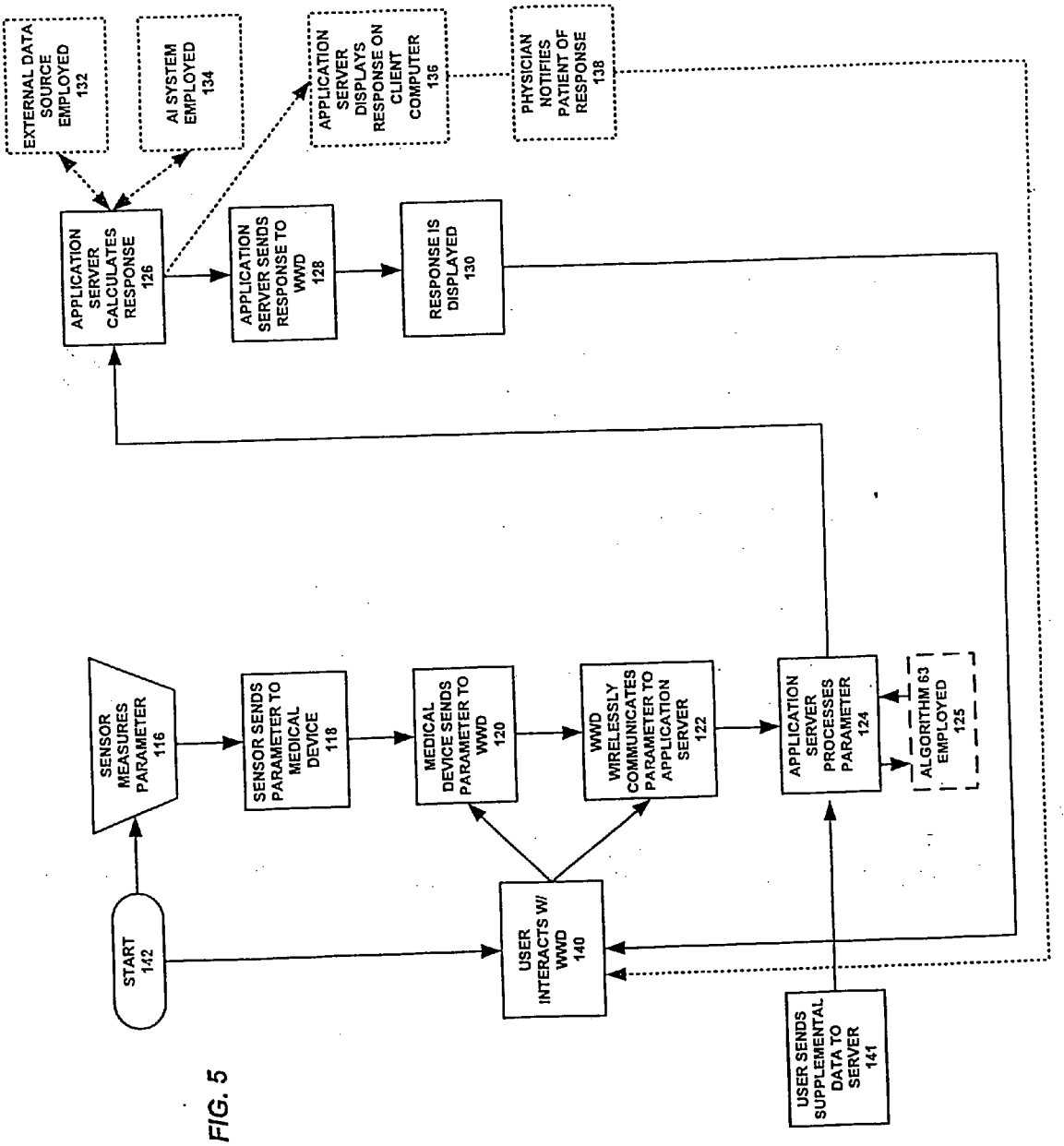
22
AI SYSTEM
76
EXTERNAL DATA
74
ALGORITHM
63
APPLICATION
62
72
Computer 37'
APPLICATION PRESENTATION LAYER
68
APPLICATION
70
MANUAL INPUT
36
SENSOR INPUT
24
WIRELESS HEALTH MONITORING APPARATUS
10

FIG. 4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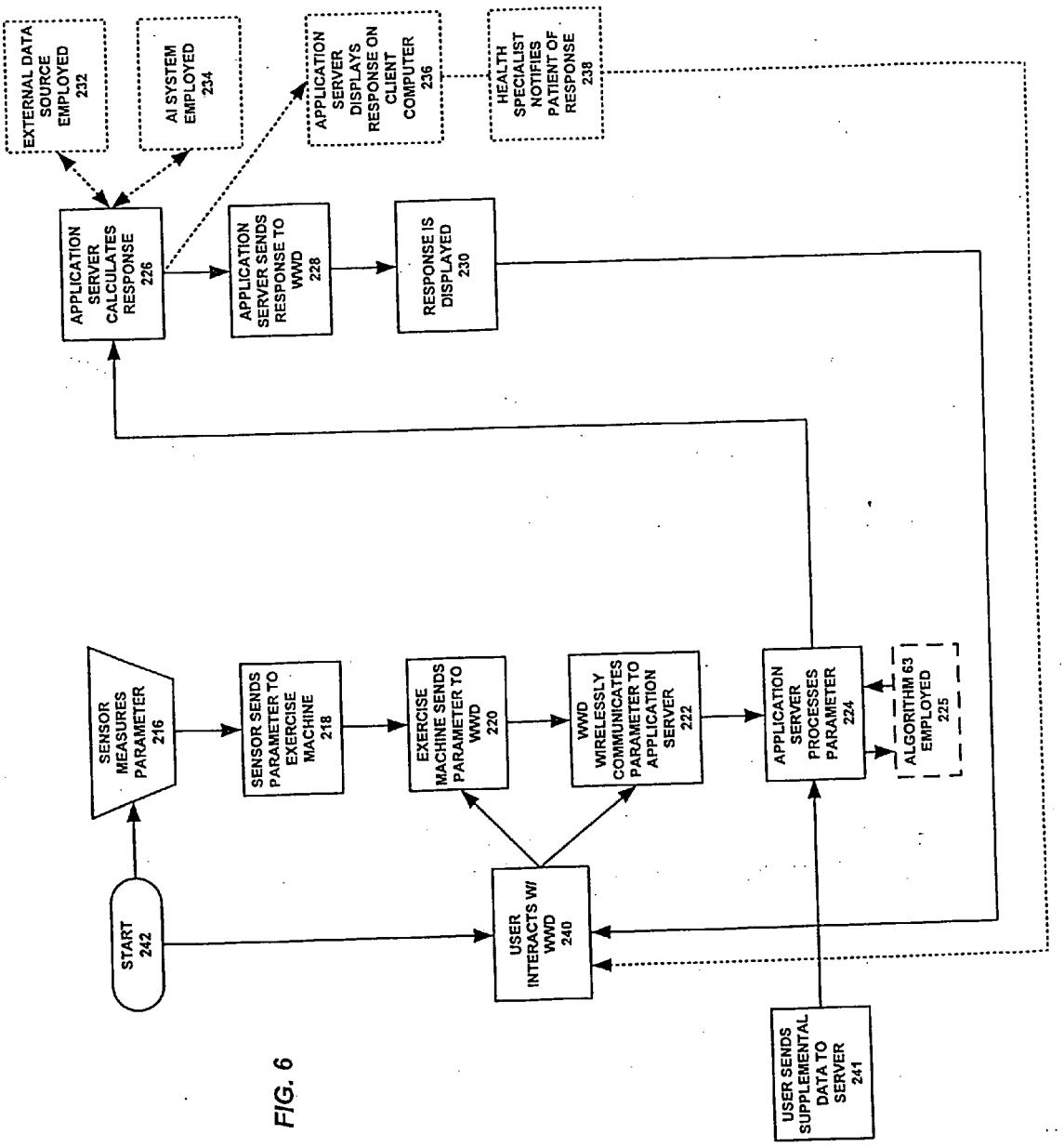
APPLICATION SERVER PROCESSES PARAMETER 124
ALGORITHM 63 EMPLOYED 125
START 142
USER INTERACTS W/ WWD 140
USER SENDS SUPPLEMENTAL DATA TO SERVER 141

FIG. 5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EXERCISE MACHINE SENDS PARAMETER TO WWD 220
WWD WIRELESSLY COMMUNICATES PARAMETER TO APPLICATION SERVER 222
APPLICATION SERVER PROCESSES PARAMETER 224
ALGORITHM 63 EMPLOYED 225
START 242
USER INTERACTS W/ WWD 240
USER SENDS SUPPLEMENTAL DATA TO SERVER 241

FIG. 6

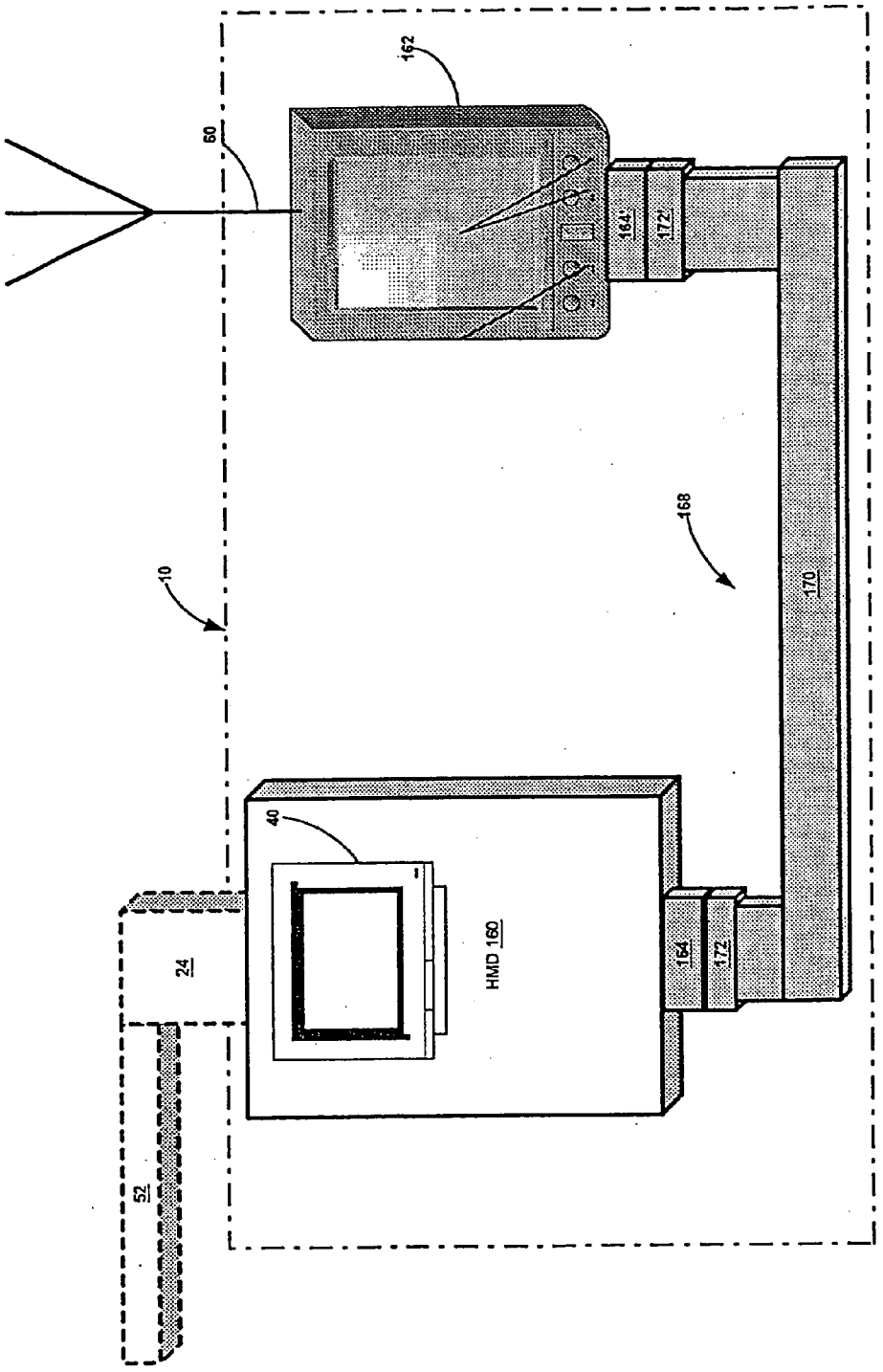

FIG. 7

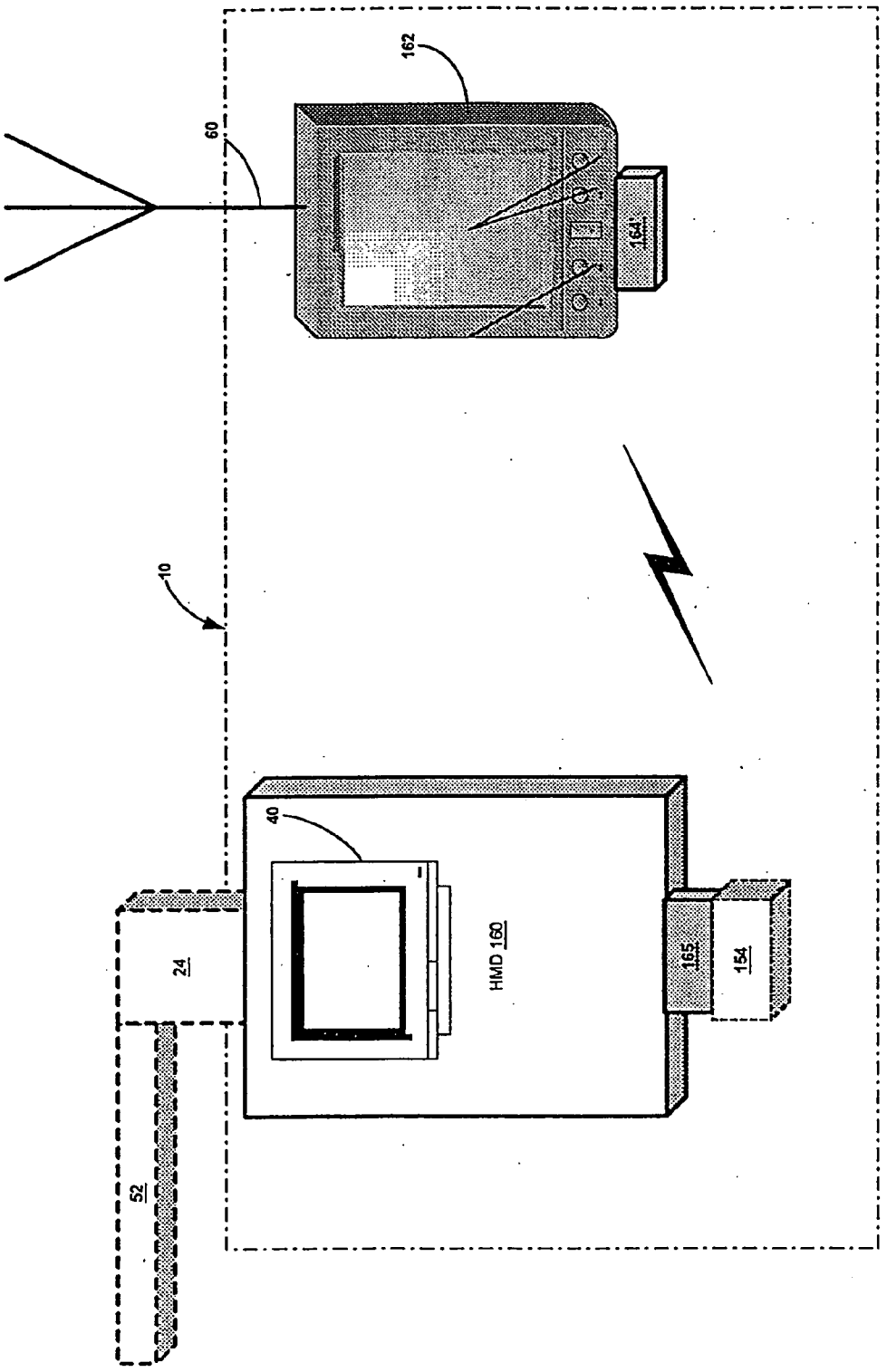

FIG. 8

METHOD AND APPARATUS FOR HEALTH AND DISEASE MANAGEMENT COMBINING PATIENT DATA MONITORING WITH WIRELESS INTERNET CONNECTIVITY

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of co-pending U.S. patent application Ser. No. 09/738,270, filed on Dec. 15, 2000, entitled "Method and Apparatus for Health and Disease Management combining Patient Data Monitoring with Wireless Internet Connectivity, which claims priority benefit of U.S. Provisional Patent Application Ser. No. 60/172,486 filed Dec. 17, 1999, entitled "Method and Apparatus for Health and Disease Management Combining Patient Data Monitoring with Wireless Internet Connectivity".

REFERENCE TO GOVERNMENTAL SUPPORT

[0002] (none)

REFERENCE TO MICROFICHE APPENDIX

[0003] (none)

FIELD OF THE INVENTION

[0004] The present invention relates to monitoring of living subjects, and more particularly to health-monitoring of persons where measured or input health data is communicated by a wireless device to and from a software application running on an internet-connected server and where the same may be studied and processed by the software application, a health professional, or the subject.

BACKGROUND OF THE INVENTION

[0005] Several attempts have been made in the past to achieve efficient interactive communication of medical or health information between a subject or patient and a reviewer or provider of that information. In particular, communication of consumer physiological information has been a subject of such attempts. It is noted that in this regard the "reviewer or provider of medical or health information" is understood to include not only a physician but also a software application or algorithm that may analyze the information.

[0006] Medical or health information has been made available on a CD-ROM accessible by a home computer system. This passive approach had certain disadvantages. First, although the personal computer is prevalent is the United States, it is generally too expensive for a consumer physiological monitoring system and there are many people who find it too complicated to set up and use for that purpose. High-risk, chronically ill patients, responsible for more than half of health care costs in the United States and forming the fastest growing segment of those requiring health care, are indeed the most likely not to be able to afford or use a system built around a personal computer. In addition, such systems are limited in their interactivity to the information stored on the CD.

[0007] Previous patents by the Inventor addressed both of these disadvantages, as well as the need to reduce health care costs through providing educational health care information and interactive physiological monitoring in the home environment by means of a user-friendly, interactive system (see, e.g., U.S. Pat. Nos. 5,601,435, 6,144,837, and continuations thereof).

[0008] These previous patents were based on a video game console, or a multimedia player using a conventional television screen as the display device to achieve a system which is simpler to use than systems based on a personal computer. An initial embodiment of the previous patents utilized a compact disc to provide interactive information for disease management.

[0009] Even with the advantages provided, these systems limited the user to location in which the device was located. Even where devices are portable, as in the case of a laptop computer with a modem, an ordinary POTS phone line must be found and used. Where the user's computer employs a broadband connection, such as DSL or satellite, the choices of location are even more limited.

[0010] Attempts have been made to remedy this deficiency. For example, many telemetry systems allow a "wireless" distance to be placed between a health measuring unit and a remote monitoring system. However, such systems are limited in their range.

[0011] Other systems have used cellular telephone technology to increase the wireless health monitoring range. However, these systems have several deficiencies, such as requiring significant modification of the mobile phone. For example, U.S. Pat. No. 5,772,586, issued Jun. 30, 1998 to Heinonon et al., discloses a method for monitoring the health of a patient. This system uses a specialized connection between the patient health measuring unit and the cellular phone, however. The patient health measuring unit is located in the battery space of the mobile phone and is connected to a communication bus of the mobile phone. Other systems have been proposed, but these suffer from similar deficiencies in that they are not designed to be used with "off-the-shelf" wireless devices or health measuring equipment.

[0012] The deployment of the above systems also currently lacks employment of full back-end server functionality with which to provide a wide range of interactive communication with the patient. Instead, such systems, if internet-enabled, are often limited to mere one-way non-interactive data transfer via a modem. While some systems are more enhanced, including that disclosed in U.S. Pat. No. 5,357,427, issued Oct. 18, 1994 to Langen, et al., and entitled "Remote Monitoring of High-Risk Patients using Artificial Intelligence", these systems are limited by the wired telecommunications infrastructure.

SUMMARY OF THE INVENTION

[0013] Embodiments of the present invention overcome one or more of the disadvantages of the prior art by providing a full-feature health-monitoring system that may wirelessly connect to a back-end server application via the internet. The invention allows wireless access to and from a wide variety of present medical or health-related instruments and devices, while maintaining the capability of connecting to future such devices.

[0014] In particular, the invention may be embodied in several systems. Two complementary such systems are

described herein, although extensions to other such systems can be envisioned. First, an embodiment of the invention may be employed to manage the disease state or condition of a patient. In this embodiment, the patient may employ a health monitoring device ("HMD"), in particular a medical device, and a wireless connection provides data from the medical device for processing via the internet including a review by a physician or other health care professional if required.

[0015] In the second embodiment, a health or lifestyle management plan may be implemented. Various health parameters, such as those relating to nutrition or exercise, may be entered into a health monitoring device, in this instance termed an "exercise machine", and the same may be wireless communicated to a server. An application may process and store the health parameters, and a health specialist may optionally review the same.

[0016] Wireless internet connectivity has many advantages. For example, in the first embodiment, a diabetic could connect a blood glucose meter to an internet-enabled wireless web device ("WWD") away from home and download data to a Diabetes Management Company's server and, in response, receive guidance displayed on the screen (or by voice) about choices for the next meal.

[0017] Alternatively, in the second embodiment, a person interested in tracking an exercise program may take the WWD to the local health club and attach the same to an exercise machine, send data output from various exercise machines over the Internet, and receive a personalized response from the server of a company specializing in Health & Lifestyle Management. The individual may input caloric content of foods eaten, and may further input caloric content of exercise performed. In this way, e.g., a person in a weight-loss program may see in great detail whether they are expending more calories in the form of exercise than the same individual is consuming in the form of food.

[0018] In general, in the health management embodiment, the system may be employed to monitor the physiologic status of a healthy subject while eating, exercising, or performing other activities. For clarity, such devices are termed herein "exercise machines". These may include an electronic body weight scale, a body fat gauge, biofeedback devices, physiotherapy or chiropractic equipment, blood pressure recorders, or the like, or any type of exercise machine or monitor, including a heart rate monitor, treadmill, rowing machine, stepper, or the like.

[0019] In more detail, the present invention provides a method and system for assisting patients to manage a disease or maintain healthy lifestyle by collecting health-related data and providing information in response to those data by means of a WWD designed to display interactive information through a connection to the Internet. The present invention may be connected to various HMDs, both medical and exercise-related in nature, and may communicate information via a wireless connection such as a wireless Internet connection.

[0020] A major advantage of embodiments of the invention is that the same frees the patient from the constraints of wired systems. The same allows users with consumer "off-the-shelf" wireless devices to significantly extend the range of connectivity over that of wired computer, television, or even wireless telemetry systems.

[0021] In a first embodiment of the present invention, the WWD is a web-enabled cellular phone. Here it is noted that the term "web" or "internet" are used interchangeably to refer to the internet in general. In a second embodiment, the WWD is a palm, handheld, or laptop computer, or a PDA, equipped with a wireless modem. In a third embodiment, the WWD may be a hybrid device that combines the functions of a computer, PDA and telephone.

[0022] An adaptor is used if necessary to convert the output signal of the medical monitoring device to a suitable input signal for the WWD. The adaptor allows connection of the WWD to a medical device, exercise machine or other variety of health care equipment, and the connection may be made via several techniques. As for wired techniques, a standard parallel bus or serial cable may be used if the input/output ports between the HMD and the WWD are appropriate. Otherwise, a suitable separate adaptor may be employed.

[0023] The connection may also be an input such as a disk drive or other media input for input of data, a USB port or phone jack or other such wired input, again employing an adaptor if required.

[0024] As for wireless techniques, infrared (IR), microwaves, radio frequency (RF), e.g., Bluetooth® or 802.11 protocols, optical techniques including lasers, and other such techniques may be used. The patient or subject may also input data manually, such as by a stylus, keypad, synchronization from a PC, or by various other techniques discussed below.

[0025] A major advantage of the invention is that by use of an optional adaptor, the system is compatible with current and prior HMDs as well as maintaining a capability of adapting to future such systems.

[0026] Other advantages of the invention may include one or more of the following. An embodiment of the invention may be used when a patient is traveling or otherwise away from their "wired" means of communication. The invention allows wireless health-monitoring to the level of accuracy previously achieved only by desktop so-called "wired" computer systems. The invention is protocol-independent.

[0027] The interaction between a WWD and a back-end server may provide a major additional advantage in certain embodiments of the invention. In particular, the relatively small amount of memory currently provided on a WWD as compared to a back-end server severely limits the functionality of applications running on the WWD, especially in terms of computing capacity, processing power, and user interface. By providing significant application functionality on the back-end, less memory and processing capabilities become necessary on the WWD (i.e., on the "front-end"). Thus, memory may be used in the WWD for an enhanced user interface or for other purposes, according to the user requirements.

[0028] In a method according to an embodiment of the invention, the patient connects to a specific Internet site and a software program, resident on a remote server located on the Internet, downloads an interactive user interface for that patient and an application for the measurement of the physiological data. The software may also be downloaded to the WWD from a personal computer via a synchronization operation in known fashion. The software provides a per-

sonalized display for the user and configures the WWD to control and monitor devices connected via a generic input/output port to the WWD. The software may be designed to suit the constraints of the small display screens of WWDs. The software, as well as inputs from the patient or other inputs, can control the manner, content, and display of information presented to the patient, and measured or input data can be stored for review by a health care provider or by a software algorithm or application. The algorithm may be of varying complexity, from a simple program that merely acknowledges receipt of information to an artificial intelligence algorithm, such as an expert system, collaborative filtering system, rules based system, case-based reasoning system, or other such artificial intelligence application.

[0029] Further information may be provided to or from the patient, including information entered manually. The patient may input this information via a personal computer, which then may download the input information to the WWD via a synchronization operation using standard protocols, such as those for Palm PDA devices.

[0030] The user may also input supplemental information via a PC connected independently to the server via the internet. Such supplemental information may include data that is difficult or inconvenient to input on the WWD. In this way, the patient may be afforded a more convenient environment in which to manipulate data to supplement the data input to the WWD. The deployment of voice processing technology may be used to enable an even more convenient user interface: i.e., one to which patients can talk.

[0031] In all of these respects, the portable aspect of the WWD is important: to wit, the user may conveniently carry the WWD on their person wherever they may go, allowing data entry at the time needed.

[0032] Other aspects, features, and advantages will be apparent from the summary above, as well as from the description that follows, including the figures and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] **FIG. 1** illustrates a general embodiment of a wireless health-monitoring system according to the present invention;

[0034] **FIG. 2** illustrates an embodiment of a wireless health-monitoring apparatus according to the present invention, showing the system of **FIG. 1** up to a point of a wireless antenna;

[0035] **FIG. 3** illustrates an embodiment of a back end of a health-monitoring system according to the present invention;

[0036] **FIG. 4** illustrates a data flow diagram according to an embodiment of the present invention;

[0037] **FIG. 5** illustrates an embodiment of a method of use for a wireless application and a server application according to the present invention, in which the same is implemented for disease and patient management;

[0038] **FIG. 6** illustrates an embodiment of a method of use for a wireless application and a server application according to the present invention, in which the same is implemented for health management;

[0039] **FIG. 7** illustrates an embodiment of a wired connection between a HMD and a WWD, also showing an optional adaptor; and

[0040] **FIG. 8** illustrates an embodiment of a wireless connection between a HMD and a WWD, also showing an optional adaptor.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0041] Various acronyms are used for clarity herein. Definitions are given below.

[0042] The term "HMD" may encompass not only devices with physiologic sensors but also devices with a keypad, keyboard, mouse, pointer, pressure sensor, or other such inputs that the patient or user may employ to perform data entry of the desired parameters. In general, HMDs include some means for determining a health parameter.

[0043] In a disease management embodiment, an HMD may be a blood glucose monitor, a blood pressure monitor, an ambulatory ECG recorder, a respiratory monitor, a temperature or heart rate monitor, and so on.

[0044] In a healthy lifestyle management embodiment, an HMD may be an exercise machine, including treadmills, rowers, steppers, exercise cycles, or other aerobic or anaerobic exercisers, or a monitor, include monitors for temperature, heart rate, blood pressure, amount of work or rate of work performed, etc.

[0045] The term "subject" as used herein primarily indicates a human subject. The same may be a medical patient under physician care, a person interested in maintaining health via accurate recording of nutrition and exercise, and so on. The term "user" is generally used to refer to the user of the device, which may be synonymous with the subject or may alternatively be a caregiver of the subject, etc. The term "patient" is used, in addition to a person under the care of a physician, to also refer to a "normal" or healthy individual who is interested in maintaining a healthy physiologic balance.

[0046] The term "signal communication" is used to mean any type of connection between components where the connection is, e.g., electromagnetic, and where the connection allows information to be passed from one component to another. This term may be used in a similar fashion as "coupled", "connected", "information communication", "data communication", etc. The following are examples of signal communication schemes. As for wired techniques, a standard bus or serial cable may be used if the input/output ports are compatible and an optional adaptor may be employed if they are not. As for wireless techniques, IR, microwaves, RF, e.g., Bluetooth® or 802.11 protocols, optical techniques including lasers, and other such techniques may be used. The patient or subject may even input data manually, such as by a stylus or keypad or by various other techniques discussed above and below.

[0047] The term "generic input/output port" is used to mean any type of convention, standard, universal, stock, consumer, or "off-the-shelf" type of port for data input and output. These may include both wired and wireless ports. A further description is given below.

[0048] Various embodiments of the invention are now described in more detail.

[0049] Referring to **FIG. 1**, a system of the present invention is shown for monitoring health data from a patient or subject **38**. The system includes a wireless health-monitoring apparatus ("WHMA") **10** described in further detail below. WHMA **10** is linked in a wireless fashion to a wireless connection point of presence ("POP") **19**, the same including at least a base station antenna **15** coupled to a server **17**. Server **17** is in turn connected to the wired, or even a wireless (not shown) Internet **21**, which may include the World Wide Web.

[0050] Referring to **FIG. 2**, an first embodiment of WHMA **10** is shown. WHMA **10** includes an HMD **11**, which may include an optional monitor screen **40**, coupled via an optional adaptor **42** to a WWD **12**. WWD **12** connects wirelessly via an antenna **60** to base station **15** (see **FIG. 1**). One function of WWD **12** is to provide the user interface; other functions are described below.

[0051] As noted above, HMD **11** may include a physiologic sensor **24** or may include a manual system **36** for input of physiologic data via a connection **34**. Manual system **36** may also be used to input data directly into WWD **12** via a connection **32**. Manual system **36** may include, e.g., a keyboard **30**, a mouse **26**, a pen-type device **28**, and may also employ a separate monitor (not shown). Of course, the user may also view information on monitor **40** or on a screen **41** of WWD **12**. In many embodiments, the stylus-based system employed by many current PDA's, such as the Palm®, may be preferred for such manual data input.

[0052] Data may also be input via entry on a computer **37**. This data may then be synchronized to WWD **12** in known fashion. Alternatively, computer **37**, or another computer (see computer **37'** in **FIG. 4**) may be used to connect to a server using the wired internet. This use may be particularly advantageous when entering a large amount of data, such as a patient's medical history. As noted above, in this way the patient may be afforded a more convenient environment in which to manipulate data to supplement the data input to the WWD.

[0053] It will be clear to one of skill in the art given this teaching that cable **32**, as well as cables **34** and **44**, may be replaced with wireless circuitry to communicate signals wirelessly.

[0054] For medical devices and applications, physiologic sensor **24** may include, e.g., a sensor appropriate for measuring blood glucose levels, blood pressure, heart rate, or any other desired parameter as required by the physician. Sensor **24** may connect via an optional cable **44** to subject **38**. Alternatively, sensor **24** may be distal of HMD **11**, i.e., at or within subject **38**. In other words, if cable **44** is employed, sensor **24** may be proximal or distal of cable **44**. If a wireless communications capability is added, sensor **24** need not physically connect with HMD **11** or WWD **12** at all. That is, the same may measure a health parameter and may communicate the same to wireless health-monitoring apparatus **10** wirelessly. The short range wireless communications schemes which may be employed include infrared, radio frequency including Bluetooth or 802.11, or other such schemes.

[0055] As examples of sensor types, to measure blood glucose levels, sensor **24** may be a sensor that accepts a drop of blood, e.g., via a finger-prick. To measure heart rate, sensor **24** may be placed via an adhesive sensor disposed on the chest. Other health monitors may also be employed so long as the measured data may either be transferred to WWD **12**, e.g., via optional adaptor **42**, described in further detail below, or by being read by a user, e.g., from a display, and manually input to WWD **12**. Alternatively, the measured data may be transferred to WWD **12** via wireless communication schemes, such as RF includes Bluetooth® or 802.11, infrared, optical, microwaves, etc., directly from sensor **24** or from HMD **11** as described in greater detail below.

[0056] The user, who may or may not be the same person as subject **38**, may input data to WWD **12** from history or experience. For example, in a health or exercise device, if subject **38** consumes a known number of calories, this information may be entered via manual system **36** directly into WWD **12** or into HMD **11**. Further, the user, the subject, and the sensor are not necessarily the sole sources of information. Data stored on the server, or on a separate server operated for health management may also be employed to result in a health benefit to subject **38**.

[0057] Referring to **FIG. 3**, WHMA **10** is shown communicating wirelessly with the Internet. In doing so, WHMA **10** generally sends a wireless signal to a base station **14** (in known fashion) that is connected to a server **18** that is in signal communication (in known fashion) with the internet. Server **18** communicates via a protocol (in known fashion) to Internet **20**, which also communicates via a protocol (in known fashion) to a server **22** running an application **62**. Server **22** may be accessed (in known fashion) by a client computer **44** through a connection **64**.

[0058] As noted, the protocols for data communication are known. However, they currently vary amongst known techniques. The present invention is not limited to any particular protocols, and may be implemented in any languages supported by the WWD and server. Of course, as computing capabilities continue to increase, it is expected that the capabilities of WHMA **10**, servers **18** and **22**, as well as application **62** and client **44**, and other components, will correspondingly increase.

[0059] Application **62** running on server **22** may interact with WHMA **10** in a number of ways. Referring to **FIG. 4**, WHMA **10** is shown in signal communication with server **22** via a connection **72**. Connection **72** schematically represents the wireless Internet connection and intervening pathways. WHMA **10** includes an application that may be viewed as having two components: a base wireless or device application **70** and an application presentation layer or user interface **68**. User interface **68** is employed to, e.g., present a menu of options to the user, to allow the user to choose inputs, and to generally operate the device. User interface **68** may vary widely in sophistication, e.g., from a simple data entry field to a full graphical user interface. These applications may accept as inputs data from a sensor **24** as well as from a manual input **36**.

[0060] Server **22** has a base server application **62** with which the same calculates or provides a response based at least in part on data from WHMA **10**. Application **62** may include an algorithm **63** for analyzing data from the HMD, and either application **62** or algorithm **63** may optionally access data from an external data source **74** and may further consult an artificial intelligence system **76**.

[0061] External data source **74** may be a memory or disk or other such storage that stores health data, such as healthy and unhealthy weight/height ranges, healthy and unhealthy cholesterol counts, the patient's or subject's prior medical or health history, healthy and unhealthy blood pressure values, information corresponding to the caloric and other nutritional content of foods, information corresponding to the caloric expenditure values of various exercises, algorithms for calculating various health parameters, etc. In general, any data that may benefit the health of a subject or patient may be stored in external data source **74**. External data source **74** may also include online access of health information from external web sites, ftp servers, or other sources.

[0062] Due to the current relatively small amount of memory and storage available on current WWDs, such external application processing as by application **62** and external data storage as by external data **74** may be particularly important.

[0063] As noted, application **62** or algorithm **63** may also consult AI system **76** for suggestions as to health benefits. AI system **76** may even interact with external data source **74** to extract useful information from the same. AI system **76** may employ, e.g., case-based reasoning, rules-based systems, collaborative filtering, neural networks, expert systems, or other such systems as are known.

[0064] It should also be noted that each of application **62**, algorithm **63**, external data source **74**, or AI system **76**, may physically reside on more than one server, e.g., on an array of servers for, e.g., storage or multiple processing purposes. Each of application **62**, algorithm **63**, external data source **74**, or AI system **76**, or combinations of each, may also respectively reside on different servers.

[0065] The extent to which server application **62** interacts with wireless application **70** depends on the use to which the system is put. For example, in a less interactive embodiment, device application **70** may act to measure a diabetic patient's blood glucose level and report the same to server application **62**. In this case, a physician may simply review the measured value and send the patient an email reporting that the value is acceptable or not. In a highly interactive embodiment, a patient may have numerous HMDs **11** connected via optional adaptors to a WWD **12**, and wireless application **70** may correspondingly send a large amount of health data to server application **62**. The physician, accessing server application **62**, may in turn send detailed care plans to a caregiver via connection **72**. The received data may be analyzed using algorithm **63**, external data source **74**, and AI system **76**. In this sense, the two applications may be highly interactive.

[0066] It is noted that an Application Service Provider (ASP) may operate application **62**. That is, application **62** may be leased by an ASP to the health care provider, and the ASP may perform all necessary upgrades and maintenance to application **62** and its associated components.

[0067] To initialize the system, the program starts and a wireless application is loaded into the WWD. The loading of the wireless application may occur via synchronization from a desktop or via downloading from a server over the internet. The server application may be loaded into an appropriate internet-connected server. Subject data may be loaded into the WWD or into the server. In the latter case, the subject information may later be transferred to the WWD or transferred to the server from the WWD, as called for by the application. The initialization scheme then ends.

[0068] The wireless application may access the server and server application, or vice-versa, as determined by the respective program instructions. Examples are now given for (1) a system of disease and patient management and (2) a system for health management employing an exercise machine.

[0069] Example Employing System for Disease Management

[0070] Referring to **FIG. 5**, an example is given for a system of disease and patient management. In this figure, as well as in **FIG. 6**, boxes in dotted lines may generally be considered optional.

[0071] In **FIG. 5**, a medical device may determine health parameters and an optional physician review is provided. Health parameters may also be determined by user manual input.

[0072] The program is started (step **142**) and a sensor measures a health parameter (step **116**). The sensor may send the parameter to a medical device (step **118**). The medical device then sends the parameter to the WWD (step **120**). The WWD then wirelessly communicates the parameter to the application server (step **122**), e.g., via the wireless web. The application server processes the parameter (step **124**), and calculates or provides a response (step **126**) based at least in part on the parameter. The application server may optionally employ algorithm **63** (step **125**), external data (step **132**) or an AI system (step **134**) in the calculation. The application server then sends the response to the WWD (step **128**), where the response is displayed (step **130**).

[0073] It should be noted that the term "response" here is used generally may simply be an acknowledgement that the parameter was received by the application server. The term "calculate" is also used generally, and may entail a simple calculation as well as a complex one. A result may, e.g., be the result of a calculation.

[0074] As noted above, the sensor may connect to any type of medical device or other such device in which information pertaining to a patient's disease or condition may be ascertained. The parameter may be any value corresponding to such information.

[0075] The method may also use a manual input as shown. In this case, after the start (step **142**) of the application, the user may interact with the WWD (step **140**). The interact may be a data input, a command to read data from a medical device, a response to a physician question or statement, an acknowledgement of physician notification, etc. Calculations by the application server may further take into account supplemental data sent by the user to the server, e.g., in a wired fashion directly over the internet (step **141**).

[0076] **FIG. 5** also shows a physician review and notification. In this option, the responses are displayed on a client computer (step **136**) in signal communication with the application server. A physician may then review the response on the client computer, and notify the patient of the responses (step **138**). For example, the physician may notify the patient of positive or negative responses. Of course, it should be noted that the "client computer" may simply be a

pager, PDA, WWD, or other such device, as well as a more typical desktop or laptop computer.

[0077] In one implementation, a diabetic may keep a database on a server of a dietary history and a blood glucose history. With this data at-hand wirelessly, the diabetic may choose whether to eat a particular food by entering nutritional information about the food into a WWD, transmitting the same wirelessly to the server, and receiving a recommendation from the server. The recommendation may be based on the food and also on data or information that had previously been transmitted wirelessly, including data from a blood glucose monitor, data input manually, if any, as well as data from algorithm **63**, external data source **74**, and AI system **76**.

[0078] Example Employing System for Health Management Using a General Exercise Machine

[0079] Referring to **FIG. 6**, an example is given for a system of health, nutrition, and/or exercise management. In this example, the HMD is an exercise machine as that termed has been defined above.

[0080] The program is started (step **242**) and a sensor measures a health parameter (step **216**), where the health parameter corresponds to health, fitness, nutrition, exercise, etc. The sensor may send the parameter to the exercise machine (step **218**). It is understood here that the "sensor" may be, e.g., a blood pressure monitor, but may also be a simple device connected to an aerobic exerciser that tracks miles ran, work performed, etc.

[0081] The exercise machine then sends the parameter to the WWD (step **220**). The WWD wirelessly communicates the parameter to the application server (step **222**), e.g., via the wireless web.

[0082] An alternative and complementary way of entering the parameter is by user input (step **248**). For example, the user may enter the parameter into the exercise machine or into the WWD. This parameter may correspond to an amount of exercise performed, an amount of food consumed, etc.

[0083] Calculations by the application server may also take into account supplemental data sent by the user to the server, e.g., in a wired fashion directly over the internet (step **241**).

[0084] The application server processes the parameter (step **224** and optionally step **225**), and calculates a response (step **226**) based at least in part on the parameter. The application server may optionally employ external data (step **232**) or an AI system (step **234**) in the calculation. The application server then sends the response to the WWD (step **228**), where the response is displayed.

[0085] The same definitional statements regarding the terms "response", "calculate", "sensor", etc., as given before, apply in this embodiment as well.

[0086] As an optional step, a health specialist may notify the patient or subject of the response (step **238**) after having the same displayed on their client computer (step **236**). The health specialist may be replaced in this example by an application that may also include an algorithm.

[0087] Adaptor Hardware

[0088] A description is given below of a particular type of adaptor hardware. As noted above, the adaptor may optionally be used to connect a HMD to a WWD.

[0089] In general, a connection is necessary between a HMD **11** and a WWD. The nature of this connection may vary. For example, the connection may be wired or wireless. For wired systems, the connection may be direct or an adaptor may be employed, either on one or both ends of the direct wired connection, to adapt the signal appropriately. In the same way, for wireless systems, the connection may be direct, if both HMD and WWD employ the same wireless protocol, or an adaptor may be involved to modify the signal of one or both devices. These connections, all of which are encompassed by the present invention, are discussed in more detail below.

[0090] Referring to **FIG. 7**, an embodiment of the connection is shown. In this figure, a hardware (or "wired") connection is shown, i.e., an adaptor **168**, disposed between a HMD **160** and a WWD **162**. In most circumstances, it is assumed that the varieties of HMDs will vary more widely than the varieties of WWDs. Accordingly, HMD **160** will likely have one of a variety of types of connectors for input/output purposes, here shown as a connector **164**. Connector **164** mates with a connector **172** of adaptor **168**. At another point on adaptor **168** is a connector **172'** for connecting to a generic input/output port **164'** on WWD **162**. A cable **170** is disposed between the two connectors, cable **170** capable of including adaptor circuitry if desired.

[0091] Of course, the use and structure of adaptor **168**, between HMD **160** and WWD **162**, depends on factors such as the prevalence of an industry standard for such communications. In other words, if the output of HMD **160** is readily acceptable to WWD **162**, then the same may be directly connected or may be connected via a simple cable, the same basically extending from pin-to-pin. For example, a standard parallel bus or serial cable may be used if the input/output ports between the HMD and the WWD, which may be, e.g., RS232, are compatible. Otherwise, a suitable adaptor circuit as noted above may be employed. The connection may also be an input such as a disk drive or other media input for input of data, a USB port or phone jack or other such wired input, again employing an adaptor circuit if required.

[0092] It is noted as exemplary that several of the most prevalent PDA's currently employs the Palm® operating system. The same may be connected to the Internet in a wireless fashion using one of several available networks. In one version of a Palm® device, a 10-pin RS-232 serial port is provided. In this version of the Palm®, port **164'** can be used to communicate with HMD **160** and connector **164** via the optional adaptor **168** according to the following pin-out:

Pin	Name	Function
1	DTR	Data Terminal Ready signal
2	VCC	3.3 Volts
3	RD (in)	Receive data
4	RTS (out)	Request to send
5	TD (out)	Transmit data

-continued

Pin	Name	Function
6	CTS (in)	Clear to send
7	GP1 (in)	Interrupt line
8	GP2 (in)	modem sync
9	unused	unused
10	GND	signal ground

[0093] On the other side of optional adaptor **168**, i.e., HMD **160**, connector **164** may vary more widely. It is noted that certain exercise machines are equipped with DB9 or DB25 RS232 serial connectors. In this case, the pin-outs are (for a DB25):

Pin	Name	Function
1	—	Protective/shielded ground
2	TD	Transmit Data (a.k.a TxD, Tx)
3	RD	Receive Data (a.k.a RxD, Rx)
4	RTS	Request To Send
5	CTS	Clear To Send
6	DSR	Data Set Ready
7	SGND	Signal Ground
8	CD	Carrier Detect (a.k.a DCD)
9		Reserved for data set testing
10		Reserved for data set testing
11		Unassigned
12	SDCD	Secondary Carrier Detect
13	SCTS	Secondary Clear to send
14	STD	Secondary Transmit Data
15	DB	Transmit Clock (a.k.a TCLK, TxCLK)
16	SRD	Secondary Receive Data
17	DD	Receive Clock (a.k.a. RCLK)
18	LL	Local Loopback
19	SRTS	Secondary Request to Send
20	DTR	Data Terminal Ready
21	RL/SQ	Signal Quality Detector/Remote loopback
22	RI	Ring Indicator (DCE raises when incoming call detected used for auto answer applications)
23	CH/CI	Signal Rate selector
24	DA	Auxiliary Clock (a.k.a. ACLK)
25		Unassigned

[0094] A connection may simply be made by providing optional adaptor **168** with adaptor circuitry, such as within cable **170** or within a circuit box therein, so as to match up the appropriate or complementary pins.

[0095] In other embodiments, such as for devices connected to proprietary connectors, a less standard and perhaps proprietary pin-out may be required.

[0096] Referring to **FIG. 8**, an embodiment of a wireless implementation of the WHMA **10** is shown. In **FIG. 8**, a wireless connection is shown between HMD **160** and WWD **162**. HMD **160** may have an integral wireless modulator/demodulator disposed within (not shown). More likely, however, is that HMD **160** has an adaptor **154** connectable thereto which performs these functions. Adaptor **154** may plug into a connector **165** on HMD **160**. WWD **162** may have an integral wireless modulator/demodulator (not shown), although an adaptor can also be used in this context. If an adaptor is used, the same may plug into generic input/output port **164**'.

[0097] While the device shown in **FIG. 8** is described in the context of general wireless communications, various protocols may be employed. For radio frequency communications, protocols such as Bluetooth® or 802.11 may be advantageously employed. Other techniques employing a similar configuration include those employing IR, microwaves, optical techniques including lasers, and so on.

[0098] It should be understood that the above is merely exemplary, and that the form of the adaptor may vary widely between HMDs and WWDs.

[0099] It will be understood that the above description of a "Method and Apparatus for Health and Disease Management Combining Patient Data Monitoring with Wireless Internet Connectivity" has been with respect to particular embodiments of the invention. While this description is fully capable of attaining the objects of the invention, it is understood that the same is merely representative of the broad scope of the invention envisioned, and that numerous variations of the above embodiments may be known or may become known or are obvious or may become obvious to one of ordinary skill in the art, and these variations are fully within the broad scope of the invention. For example, while certain wireless technologies have been described herein, other such wireless technologies may also be employed. Furthermore, while various types of medical devices have been mentioned, numerous other types may also be used in the embodiments of the invention, including pulse oximeters, syringe drivers, infusion pumps, spirometers, ventilators, anesthesia monitors, and so on. Accordingly, the scope of the invention is to be limited only by the claims appended hereto, and equivalents thereof. In these claims, a reference to an element in the singular is not intended to mean "one and only one" unless explicitly stated. Rather, the same is intended to mean "one or more". All structural and functional equivalents to the elements of the above-described preferred embodiment that are known or later come to be known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the present claims. Moreover, it is not necessary for a device or method to address each and every problem sought to be solved by the present invention, for it to be encompassed by the present claims. Furthermore, no element, component, or method step in the present invention is intended to be dedicated to the public regardless of whether the element, component, or method step is explicitly recited in the claims. No claim element herein is to be construed under the provisions of 35 U.S.C. §§112, ¶6, unless the element is expressly recited using the phrase "means for".

1. A device for monitoring health, comprising:

an internet-enabled mobile or satellite phone or wireless PDA running an application, the phone or wireless PDA having a port for communications with an implantable medical device via a wireless RF connection;

such that the application functions to accept a health parameter or measurement from the implantable medical device via the wireless connection, and

such that the application functions to transmit data corresponding to the accepted health parameter or measurement via the internet to a server.

2. The device of claim 1, wherein the wireless RF connection is selected from the group consisting of: 802.11, 802.16, and Bluetooth communication schemes.

3. The device of claim 1, wherein the implantable medical device is selected from the group consisting of: cardiac monitors, hear rate monitors, blood pressure monitors, respiratory monitors, temperature monitors, blood glucose monitors, and combinations thereof.

4. The device of claim 1, further comprising an adaptor for connection to the port to enable communication with the RF signal from the implantable medical device.

5. A device for monitoring health, comprising:

A mobile or satellite phone or wireless PDA running an application, the phone or wireless PDA having a port for communications with an implantable medical device via a wireless RF connection;

such that the application functions to accept a health parameter or measurement from the implantable medical device via the wireless connection, and

such that the application functions to transmit data corresponding to the accepted health parameter or measurement via a mobile or satellite network to a server.

6. The device of claim 5, wherein the wireless RF connection is selected from the group consisting of: 802.11, 802.16, and Bluetooth communication schemes.

7. The device of claim 5, wherein the implantable medical device is selected from the group consisting of: cardiac monitors, hear rate monitors, blood pressure monitors, respiratory monitors, temperature monitors, blood glucose monitors, and combinations thereof.

8. The device of claim 5, further comprising an adaptor for connection to the port to enable communication with the RF signal from the implantable medical device.

9. A method of using a device to monitor health, comprising:

running an application on an internet-enabled mobile or satellite phone or wireless PDA;

accepting a health parameter or measurement into the application from an implantable medical device via a wireless RF connection;

transmitting data corresponding to the health parameter or measurement to a server via the internet.

10. The method of claim 9, wherein the wireless RF connection is selected from the group consisting of: 802.11, 802.16, and Bluetooth communication schemes.

11. The method of claim 9, wherein the implantable medical device is selected from the group consisting of: cardiac monitors, heart rate monitors, blood pressure monitors, respiratory monitors, temperature monitors, blood glucose monitors, and combinations thereof.

12. The method of claim 9, further comprising connecting an adaptor to the internet-enabled mobile or satellite phone or wireless PDA to enable communication with the RF signal from the implantable medical device.

13. A method of using a device to monitor health, comprising:

running an application on an mobile or satellite phone or wireless PDA;

accepting a health parameter or measurement into the application from an implantable medical device via a wireless RF connection;

transmitting data corresponding to the health parameter or measurement to a server via the mobile phone or wireless PDA via a mobile or satellite phone network.

14. The method of claim 13, wherein the wireless RF connection is selected from the group consisting of: 802.11, 802.16, and Bluetooth communication schemes.

15. The method of claim 13, wherein the implantable medical device is selected from the group consisting of: cardiac monitors, heart rate monitors, blood pressure monitors, respiratory monitors, temperature monitors, blood glucose monitors, and combinations thereof.

16. The method of claim 13, further comprising connecting an adaptor to the internet-enabled mobile or satellite phone or wireless PDA to enable communication with the RF signal from the implantable medical device.

17. A device for monitoring cardiac health, comprising:

an internet-enabled mobile or satellite phone or wireless PDA running an application, the phone having a port for communications with an implantable cardiac monitor via a wireless RF connection;

such that the application functions to accept a health parameter or measurement from the implantable cardiac monitor via the wireless RF connection, and

such that the application functions to transmit data corresponding to the accepted health parameter or measurement via the internet or via a mobile or satellite network to a server.

18. The device of claim 17, wherein the wireless RF connection is selected from the group consisting of: 802.11, 802.16, and Bluetooth communication schemes.

19. The device of claim 17, wherein the implantable cardiac monitor monitors heart rate or blood pressure.

20. The device of claim 17, further comprising an adaptor for connection to the port to enable communication with the RF signal from the implantable cardiac monitor.

21. A device for monitoring respiratory health, comprising:

an internet-enabled mobile or satellite phone or wireless PDA running an application, the phone having a port for communications with an implantable respiratory monitor via a wireless RF connection;

such that the application functions to accept a health parameter or measurement from the implantable respiratory monitor via the wireless RF connection, and

such that the application functions to transmit data corresponding to the accepted health parameter or measurement via the internet or via a mobile or satellite network to a server.

22. The device of claim 21, wherein the wireless RF connection is selected from the group consisting of: 802.11, 802.16, and Bluetooth communication schemes.

23. The device of claim 21, further comprising an adaptor for connection to the port to enable communication with the RF signal from the implantable respiratory monitor.

24. A device for monitoring health, comprising:

an internet-enabled mobile or satellite phone or wireless PDA running an application, the phone or wireless

PDA having a port for communications with an implantable temperature monitor via a wireless RF connection;

such that the application functions to accept a health parameter or measurement from the implantable temperature monitor via the wireless RF connection, and

such that the application functions to transmit data corresponding to the accepted health parameter or measurement via the internet or via a mobile or satellite network to a server.

25. The device of claim 24, wherein the wireless RF connection is selected from the group consisting of: 802.11, 802.16, and Bluetooth communication schemes.

26. The device of claim 24, further comprising an adaptor for connection to the port to enable communication with the RF signal from the implantable temperature monitor.

27. A device for monitoring health, comprising:

an internet-enabled mobile or satellite phone or wireless PDA running an application, the phone or wireless PDA having a port for communications with an implantable blood glucose monitor via a wireless RF connection;

such that the application functions to accept a health parameter or measurement from the implantable blood glucose monitor via the wireless RF connection, and

such that the application functions to transmit data corresponding to the accepted health parameter or measurement via the internet or via a mobile or satellite network to a server.

28. The device of claim 27, wherein the wireless RF connection is selected from the group consisting of: 802.11, 802.16, and Bluetooth communication schemes.

29. The device of claim 27, further comprising an adaptor for connection to the port to enable communication with the RF signal from the implantable blood glucose monitor.

30. A method of using a device to monitor cardiac health, comprising:

running an application on an internet-enabled mobile or satellite phone or wireless PDA;

accepting a health parameter or measurement into the application from an implantable cardiac monitor via a wireless RF connection;

transmitting data corresponding to the health parameter or measurement to a server via the internet or via a mobile or satellite network.

31. The method of claim 30, wherein the wireless RF connection is selected from the group consisting of: 802.11, 802.16, and Bluetooth communication schemes.

32. The method of claim 30, wherein the implantable cardiac monitor monitors heart rate or blood pressure.

33. The method of claim 30, further comprising connecting an adaptor to the internet-enabled mobile or satellite phone or wireless PDA to enable communication with the RF signal from the implantable cardiac monitor.

34. A method of using a device to monitor health, comprising:

running an application on an internet-enabled mobile or satellite phone or wireless PDA;

accepting a health parameter or measurement into the application from an implantable respiratory monitor via a wireless connection;

transmitting data corresponding to the health parameter or measurement to a server via the internet or via a mobile or satellite network.

35. The method of claim 34, wherein the wireless RF connection is selected from the group consisting of: 802.11, 802.16, and Bluetooth communication schemes.

36. The method of claim 34, further comprising connecting an adaptor to the internet-enabled mobile or satellite phone or wireless PDA to enable communication with the RF signal from the implantable respiratory monitor.

37. A method of using a device to monitor health, comprising:

running an application on an internet-enabled mobile or satellite phone or wireless PDA;

accepting a health parameter or measurement into the application from an implantable temperature monitor via a wireless connection;

transmitting data corresponding to the health parameter or measurement to a server via the internet or via a mobile or satellite network.

38. The method of claim 37, wherein the wireless RF connection is selected from the group consisting of: 802.11, 802.16, and Bluetooth communication schemes.

39. The method of claim 37, further comprising connecting an adaptor to the internet-enabled mobile or satellite phone or wireless PDA to enable communication with the RF signal from the implantable temperature monitor.

40. A method of using a device to monitor health, comprising:

running an application on an internet-enabled mobile or satellite phone or wireless PDA;

accepting a health parameter or measurement into the application from an implantable blood glucose monitor via a wireless connection;

transmitting data corresponding to the health parameter or measurement to a server via the internet or via a mobile or satellite network.

41. The method of claim 40, wherein the wireless RF connection is selected from the group consisting of: 802.11, 802.16, and Bluetooth communication schemes.

42. The method of claim 40, further comprising connecting an adaptor to the internet-enabled mobile or satellite phone or wireless PDA to enable communication with the RF signal from the implantable blood glucose monitor.

43. A method of using a device to monitor health, comprising:

running an application on an internet-enabled mobile or satellite phone or wireless PDA;

accepting a health parameter or measurement into the application from an implantable infusion pump via a wireless connection;

transmitting data corresponding to the health parameter or measurement to a server via the internet or via a mobile or satellite network.

44. The method of claim 43, wherein the wireless RF connection is selected from the group consisting of: 802.11, 802.16, and Bluetooth communication schemes.

45. The method of claim 43, further comprising connecting an adaptor to the internet-enabled mobile or satellite phone or wireless PDA to enable communication with the RF signal from the implantable infusion pump.

46. A device for monitoring health, comprising:

an internet-enabled mobile or satellite phone or wireless PDA running an application, the phone or wireless PDA having a port for communications with an implantable infusion pump via a wireless RF connection;

such that the application functions to accept a health parameter or measurement from the implantable infusion pump via the wireless RF connection, and

such that the application functions to transmit data corresponding to the accepted health parameter or measurement via the internet or via a mobile or satellite network to a server.

47. The device of claim 46, wherein the wireless RF connection is selected from the group consisting of: 802.11, 802.16, and Bluetooth communication schemes.

48. The device of claim 46, further comprising an adaptor for connection to the port to enable communication with the RF signal from the implantable infusion pump.

49. A device for monitoring health, comprising:

an internet-enabled mobile or satellite phone or wireless PDA running an application, the phone having a port for communications with an implantable medical device via a wireless RF connection;

such that the application functions to accept health parameters or measurements corresponding to temperature, cardiac pressure, and heart rate from the implantable medical device via the wireless connection, and

such that the application functions to transmit data corresponding to the accepted health parameter or measurement via the internet to a server.

50. The device of claim 49, further comprising an adaptor for connection to the port to enable communication with the RF signal from the implantable medical device.

51. A device for monitoring health, comprising:

A mobile or satellite phone or wireless PDA running an application, the phone having a port for communications with an implantable medical device via a wireless RF connection;

such that the application functions to accept health parameters or measurements corresponding to temperature, cardiac pressure, and heart rate from the implantable medical device via the wireless connection, and

such that the application functions to transmit data corresponding to the accepted health parameters or measurements via a mobile or satellite network to a server.

52. The device of claim 51, further comprising an adaptor for connection to the port to enable communication with the RF signal from the implantable medical device.

53. A method of using a device to monitor health, comprising:

running an application on an internet-enabled mobile or satellite phone or wireless PDA;

accepting health parameters or measurements corresponding to temperature, cardiac pressure, and heart rate into the application from an implantable medical device via a wireless RF connection;

transmitting data corresponding to the health parameters or measurements to a server via the internet.

54. The method of claim 53, further comprising connecting an adaptor to the internet-enabled mobile or satellite phone or wireless PDA to enable communication with the RF signal from the implantable medical device.

55. A method of using a device to monitor health, comprising:

running an application on an mobile or satellite phone or wireless PDA;

accepting health parameters or measurements corresponding to temperature, cardiac pressure, and heart rate into the application from an implantable medical device via a wireless RF connection;

transmitting data corresponding to the health parameters or measurements to a server via the mobile phone via a mobile or satellite phone network.

56. The method of claim 55, further comprising connecting an adaptor to the internet-enabled mobile or satellite phone or wireless PDA to enable communication with the RF signal from the implantable medical device.

57. A device for monitoring health, comprising:

an internet-enabled mobile or satellite phone or wireless PDA running an application, the phone or wireless PDA having a port for communications with an implantable blood glucose monitor and an implantable infusion pump via a wireless RF connection;

such that the application functions to accept a health parameter or measurement from the implantable blood glucose monitor via the wireless RF connection,

such that the application functions to transmit data corresponding to the accepted health parameter or measurement to a server, and

such that the application functions to control the implantable infusion pump based at least in part on the accepted health parameter or measurement.

58. The device of claim 57, wherein the wireless RF connection is selected from the group consisting of: 802.11, 802.16, and Bluetooth communication schemes.

59. The device of claim 57, wherein the application further functions to accept data corresponding to food intake via a manual input.

60. The device of claim 57, further comprising an adaptor for connection to the port to enable communication with the RF signal from the implantable blood glucose monitor or implantable infusion pump.

61. A method of using a device to monitor health, comprising:

running an application on an internet-enabled mobile or satellite phone or wireless PDA;

accepting a health parameter or measurement into the application from an implantable blood glucose monitor via a wireless connection;

transmitting data corresponding to the health parameter or measurement to a server via the internet;

controlling an implantable infusion pump based at least in part on the accepted health parameter or measurement.

62. The method of claim 61, wherein the wireless RF connection is selected from the group consisting of: 802.11, 802.16, and Bluetooth communication schemes.

63. The method of claim 61, further comprising accepting data corresponding to food intake via a manual input.

64. The method of claim 61, further comprising connecting an adaptor to the internet-enabled mobile or satellite phone or wireless PDA to enable communication with the RF signal from the implantable blood glucose monitor and implantable infusion pump.

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